SECTION 16461

DRY-TYPE TRANSFORMERS

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LANL MASTER CONSTRUCTION SPECIFICATION

Edit to suit Project requirements; add job-specific requirements and delete those portions that do not apply to the Project (e.g., a component that does not apply). Contact the Engineering Standards Manual (ESM) Electrical POC to seek a variance from applicable requirements. Refer to http://www.lanl.gov/f6stds/pubf6stds/engrman/HTML/poc_techcom1.htm#elec for the Engineering Standards Manual Personnel Link Index.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Delete information within "stars" during editing.

Specification developed for ML-3 / ML-4 projects. For ML-1 / ML-2, additional requirements and QA reviews are required.

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PART 1 GENERAL

1.1 SECTION INCLUDES

A. ENERGY STAR dry-type low-voltage transformers

B. Low-temperature rise dry-type low-voltage transformers

C. K-factor rated low-voltage transformers for non-linear loads

1.2 QUALITY ASSURANCE

A. Comply with the *National Electrical Code* (*NEC*) for components and installation.

B. Provide products that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for the application, installation condition, and the environment in which installed.

C. The manufacturer of the transformers shall be a certified ISO 9001 facility.

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Edit the following article to match project conditions.

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1.3 SUBMITTALS

A. Submit the following in accordance with the provisions of Section 01330 *Submittal* Procedures.

B. Catalog Data. Include outline and support point dimensions of transformer enclosures and accessories, unit weight, voltages, kVA, impedance, sound level, tap configurations, insulation system type, and rated temperature rise.

C. Certifications signed by manufacturers certifying that their products comply with the specified requirements.

D. Operation and maintenance instructions.

1.4 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products according to NECA 1 *Standard Practices for Good Workmanship in Electrical Construction* and NECA 409 *Recommended Practice for Installing and Maintaining Dry-Type Transformers* (ANSI).

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01630 *Product Options and Substitutions.*

2.2 GENERAL

A. Transformers shall be UL 1561 listed and shall be manufactured and tested according to NEMA ST 20 *Dry Type Transformers for General Applications.*

B. Transformers shall be capable of continuous operation without exceeding temperature limits at an elevation of 7500 ft when de-rated in accordance with NEMA ST 20 as follows:

1. 97.5 percent of nameplate kVA in a 30 ºC average ambient with a maximum cooling air temperature of 40 ºC, or

2. 100 percent of nameplate kVA in a 28.5 ºC average ambient with a maximum cooling air temperature of 33.75 ºC.

C. Transformer coils may be aluminum or copper with continuous wound construction and shall be impregnated with nonhygroscopic, thermosetting varnish. Terminations shall be brazed or welded to the coil conductor.

D. Furnish transformers with suitable dielectric materials and adequate air spacings between terminals for operating at an altitude of 7500 ft.

E. Transformers 15 kVA and larger shall have a minimum of two 2.5 percent full capacity above normal and four 2.5 percent full capacity below normal primary taps.

F. Transformer cores shall be constructed of a high grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities shall be kept well below the saturation point. The core and coil shall be bolted to the base of the enclosure, isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and the enclosure. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.

G. The core of the transformer shall be visibly grounded to the enclosure by a flexible grounding conductor sized following applicable UL and NEC Standards.

H. The transformer enclosure shall be ventilated and shall be fabricated of a heavy gauge, sheet steel construction. The entire enclosure shall be finished using a process consisting of degreasing, cleaning and phosphatizing followed by electrostatic deposition of polymer polyester powder and baking cycle to provide a uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use. The coating color shall be light or medium grey.

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Edit the following article to match Project requirements; some installations may require lower sound levels

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I. Maximum sound levels shall not exceed those specified in NEMA ST 20 when tested according to IEEE Standard C57.12.91.

J. Transformers 45 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 45 KVA shall be suitable for floor or trapeze mounting. Provide mounting accessories required for installation.

K. Provide weathershields for transformers installed outdoors.

L. Provide transformer manufacturer's transformer lug kits with compression type equipment lugs and hardware for connecting conductors to transformer terminals.

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Edit the following article to match project conditions. Use ENERGY STAR labeled transformers where the average daily load will be less than 50% of the transformer nameplate rating. On the Drawings clearly indicate which transformers shall be ENERGY STAR labeled; this will typically be for general-purpose loads in office buildings and similar occupancies operating from 8 a.m. until 5 p.m. Delete this article if ENERGY STAR labeled transformers are not required.

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2.3 ENERGY STAR DRY TYPE TRANSFORMERS

A. Provide factory assembled and tested ENERGY STAR labeled air cooled, two-winding type, dry-type transformers with voltage and kVA ratings as indicated on the Drawings.

B. ENERGY STAR labeled transformers shall be manufactured and tested according to the following standards in addition to those listed in the GENERAL clause of this Section:

1. NEMA TP 1 *Guide for Determining Energy Efficiency for Distribution Transformers*.

2. NEMA TP 2 *Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.*

C. Transformers shall be low loss type with minimum efficiencies per NEMA TP-1 when operated at 35% of full load capacity. Efficiency shall be tested in accordance with NEMA TP-2.

D. Manufacturers: Square D Type "EE", Eaton/Cutler-Hammer "EE", Sola/Hevi-Duty "E".

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Edit the following article to match project conditions. Use low temperature rise dry-type transformers where the average daily load will be 50% or more of the transformer nameplate rating. On the Drawings clearly indicate which transformers shall be low temperature rise; this will typically be for process loads in laboratory buildings. Delete this article if low temperature rise transformers are not required.

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2.4 LOW TEMPERATURE RISE DRY TYPE TRANSFORMERS

A. Provide factory assembled and tested low temperature rise air cooled, two-winding type, dry-type transformers with voltage and kVA ratings as indicated on the Drawings.

B. Transformers 10 kVA and larger shall be 115 ºC temperature rise above 40 ºC ambient and shall be capable of carrying a 15% continuous overload without exceeding a 150 ºC rise in a 40 ºC ambient at sea level.

C. Manufacturers: Square D “Watchdog”, Eaton/Cutler-Hammer “DT-3”, Sola/Hevi-Duty “HF”.

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Edit the following article to match project conditions. Use K-factor rated dry-type transformers for separately derived systems serving computer or other high harmonic loads. On the Drawings clearly indicate which transformers shall be K-Factor rated. Delete this article if K-factor transformers are not required.

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2.5 K-FACTOR RATED DRY TYPE TRANSFORMERS

A. Provide factory assembled and tested, air cooled, two-winding type, dry-type transformers with voltage, kVA and K-factor ratings as indicated on the Drawings.

B. K-factor rated transformers shall be manufactured and tested according to the following standards in addition to those listed in the GENERAL clause of this Section:

1. ANSI/IEEE C57.12.01 *IEEE Standard General Requirements for Dry-Type Distribution and Power Transformers*.

2. ANSI/IEEE C57.12.91 *IEEE Standard Test Code for Dry-Type Distribution and Power Transformers*.

3. ANSI/IEEE C57.110 *IEEE Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusiodal Load Currents*.

C. Transformers shall be 115 ºC temperature rise above 40 ºC ambient at sea level. Neither the primary nor the secondary temperature shall exceed 180ºC at any point in the coils while carrying their full rating of non-sinusoidal loads. K-factors shall be defined as the sum of fundamental and harmonic $I(pu)^2h^2$ per UL 1561.

D. K-Factor rated transformers shall have an impedance range of 3% to 5%, and shall have a minimum reactance of 2% in order to help reduce neutral current when supplying loads with large amounts of third harmonic current.

E. Size transformer neutral terminal for 200% of the rated secondary phase current.

F. Transformers shall be common core construction. The core laminations above 112.5 kVA shall be miter cut at the core corners to reduce hot spots, core loss, excitation current and sound level. The core laminations shall be clamped with steel angles. Cores for transformers greater than 300 kVA shall be clamped utilizing insulated bolts through the core laminations to provide proper pressure throughout the length of the core. The completed core and coil shall then be bolted to the base of the enclosure but isolated by means of rubber, vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.

G. Transformers shall be supplied with a full width electrostatic shield resulting in a maximum effective coupling capacitance between primary and secondary of 33 picofarads. With transformers connected under normal, loaded operating conditions, the attenuation of line noise and transients shall equal or exceed the following limits:

1. Common Mode: 0 to 1.5 Hz – 120 dB; 1.5 to 10 kHz – 90 dB; 10 to 100kHz – 65 dB; 100 kHz to 1 MHz - 40dB.

2. Traverse Mode: 1.5 to 10 kHz – 52 dB; 10 to 100 kHz – 30 dB, 100 kHz to 1 MHz – 30 dB.

H. Manufacturer: Square D “NL and NLP Series”, Eaton/Cutler-Hammer “KT”, Sola/Hevi-Duty 3H”.

PART 3 EXECUTION

3.1 EXISTING WORK

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Delete this article when existing construction is not affected.

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A. Disconnect and remove abandoned dry-type transformers.

B. Maintain access to existing dry-type transformers and other installations that are to remain active and to require access. Modify installation or provide access panel.

C. Clean and repair existing dry-type transformers that are to remain or be reinstalled.

3.2 EXAMINATION

A. Examine surfaces to receive transformers for compliance with installation tolerances and other conditions affecting performance of the control system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Install dry-type transformers where indicated on the Drawings and according to manufacturer's instructions. Manufacturer’s installation instructions shall be available at the construction site.

B. Install transformers according to NECA 409 *Recommended Practice for Installing and Maintaining Dry-Type Transformers* (ANSI).

C. Set transformers plumb and level. Support dry-type transformers in accordance with Section 16070 *Hangers, Supports and, Seismic Protection.*

1. Install floor-mounted transformers on 4 inch high reinforced concrete pads. Secure transformers to pad using not less than four 1/2 inch diameter, 3 inches long, anchor bolts.

2. Install wall-mounted transformers on wall brackets manufactured by the transformer manufacturer. Do not mount transformers larger than 15 kVA on drywall construction. Secure brackets to masonry or concrete wall using not less than four 1/2 inch diameter, 3 inches, long anchor bolts. Do not wall mount transformers larger than 45 kVA. Provide seismic protection as required by Section 16070.

D. Arrange equipment to provide adequate spacing for access, replacement, and for cooling air circulation. Locate the front and rear of each ventilated transformer at least 6 inches from the wall or any obstruction to allow proper air circulation.

E. Use flexible conduits, 2 ft. minimum lengths, for connections to transformer case. Make conduit connections to transformer enclosure only at locations designated by the manufacturer's installation instructions.

F. Connect conductors to transformer terminals using transformer manufacturer's lug kits. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A.

G. Bond transformers and ground systems served by transformers according to Section 16060 *Grounding and Bonding*.

H. Identify transformers and install warning signs according to Section 16075 *Electrical Identification*.

3.4 FIELD QUALITY CONTROL

A. Clean transformers in accordance with NECA 409.

B. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to ensure removal of temporary shipping bracing before energizing transformers.

C. Inspect and test in accordance with NETA ATS and NECA 409. Correct any deficiencies before energizing dry-type transformers. Refer to Section 16080 *Electrical Acceptance Testing*.

D. Energize transformers in accordance with NECA 409.

E. Measure primary and secondary voltages and phase rotation, and make preliminary tap adjustments. After normal operating loads have been energized adjust taps to provide the following voltage at points of use; record voltages and tap settings.

System Nominal Voltage	Minimum Load Voltage
480Y/277	460Y/265
208Y/120	200Y/115
120/240	115/230

F. After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.

END OF SECTION

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Do not delete the following reference information.

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This project specification is based on LANL Master Construction Specification Section 16461 Rev. 0, October 28, 2004.